SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR – 440013

An Autonomous College affiliated to
Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur, Maharashtra (INDIA)

PROGRAMME SCHEME & SYLLABI
2020 – 2021

M. Tech. (Geotechnical Engineering)

Published By

Dr. R. S. Pande

Principal
Shri Ramdeobaba College of Engineering & Management
Ph. : 0712-2580011 Fax : 0712 - 2583237
ISO 9001 : 2015 CERTIFIED ORGANISATION

About the Department

Civil Engineering Department was established in 1984 at the time of inception of Shri Ramdeobaba College of Engineering & Management (previously RKNEC) with intake of 60 students. The department has experienced and highly qualified faculty; it is equipped with sophisticated laboratories and latest computational softwares which helps the students to develop expertise in Civil Engineering. Civil Engineering Department offers Undergraduate Programme B. E. in Civil Engineering (1st shift and 2nd shift) and two Post Graduate Programmes namely M. Tech., Structural Engineering (Full Time) and M. Tech., Geotechnical Engineering (Part Time).

The Department of Civil Engineering is one of the prime partners in success stories of the institute. The department has all the state of the art laboratories and faculties that provide excellent opportunities for students as well as researchers. The department is accredited by the National Board of Accreditation and well recognized by Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur. The department is closely associated with industry and extending its testing & consulting services. For overall development of the student, the department provides a conducive atmosphere for organization & conduction of various co- curricular and extra-curricular programs while imparting outcome based quality education.

Departmental Vision :

To be a knowledge center in civil engineering education, training, research, entrepreneurship and industry outreach services for creating sustainable infrastructure and enhancing quality of life.

Department Mission :

To generate quality civil engineers with technical and managerial skills through creation of conducive environment for creative learning and research in association with stake holders.

Programme Educational Objectives :

1. The Programme will prepare graduates to perform analysis and design of various geotechnical structures.
2. The Programme will prepare graduates to take up industrial project in the field of geotechnical engineering and allied area and also research work in the relevant domain.

Programme Outcomes :

1. An ability to independently carry out research / investigatiob and development work to solve practical problems.
2. An ability to write and present a substantial technical report / document.
3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

SCHEME OF EXAMINATION OF MASTER OF TECHNOLOGY (GEOTECHNICAL ENGINEERING) SEMESTER PATTERN

I Semester M. Tech (Geotechnical Engineering)

Sr. No.	Category	Course Name	L	T	Credits	Maximum marks			Exam Duration	Category
						Continuous Assessment	End Sem Exam	Total		
1.	CET 571	Advanced Soil Mechanics	4	-	4	40	60	100	3 Hours	PC
2.	CEP 571	Advanced Soil Mechanics (P)	-	2	1	25	25	50	--	PC
3.	CET 572	Geotechnical Exploration & Investigation	4	-	4	40	60	100	3 Hours	PC
4.	CEP 572	Geotechnical Exploration & Investigation (P)	-	2	1	25	25	50	--	PC
5.	CET 595	Engineering Computational Techniques	4	-	4	40	60	100	3 Hours	FC
		TOTAL	**12**	**4**	**14**	**170**				

SCHEME OF EXAMINATION OF MASTER OF TECHNOLOGY (GEOTECHNICAL ENGINEERING) SEMESTER PATTERN

II Semester M. Tech (Geotechnical Engineering)

Sr. No.	Code	Course Name	L	P	Credits	Maximum marks			Exam Duration	Category
						Continuous Assessment	End Sem Exam	Total		
1.	CET 573	Foundation Engineering I	4	-	4	40	60	100	3 Hours	PC
2.	CEP 573	Foundation Engineering I (P)	-	2	1	25	25	50	--	PC
3.	CET 596	Research Methodology	3	-	3	40	60	100	3 Hours	FC
4.	CET 597	Group Elective I	4	-	4	40	60	100	3 Hours	GE
5.	CEP 597	Group Elective I (P)	-	2	1	25	25	50	--	GE
6.	CET 599	Open Elective	3	-	3	40	60	100	3 Hours	OE
		TOTAL	**14**	**4**	**16**	**210**	290	500		

Course Code	Group Elective I (T + P)
CET/ CEP 597-1	Applied Soil Engineering
CET/ CEP 597-2	Finite Element Method
CET/ CEP 597-3	Instrumentation & Material Science
CET/ CEP 597-4	Soil Dynamics

Course Code	Open Elective
CET 599-1	Advanced Construction Materials & Techniques
CET 599-3	Prestressed Concrete Structure

SCHEME OF EXAMINATION OF MASTER OF TECHNOLOGY (GEOTECHNICAL ENGINEERING) SEMESTER PATTERN

III Semester M. Tech. (Geotechnical Engineering)

Sr. No.	Code	Course Name	L	P	Credits	Maximum marks			Exam Duration	Category
						Continuous Assessment	End Sem Exam	Total		
1.	CET 598	Group Elective - II	4	-	4	40	60	100	3 Hours	GE
2.	CET 671	Ground Improvement	4	-	4	40	60	100	3 Hours	PC
3.	CEP 671	Ground Improvement	-	2	1	25	25	50	-	PC
4.	CET 672	Earth and Rockfill dams	4	-	4	40	60	100	3 Hours	PC
5.	CET 673	Foundation Engineering - II	4	-	4	40	60	100	3 Hours	PC
		TOTAL	**16**	**2**	**17**					

Course Code	Group Elective II
CET 598-1	Design of Bridges
CET 598-2	Design of Environmental Structures
CET 598-3	Geo-Environmental Engineering
CET 598-4	Soil Structure Interaction

SCHEME OF EXAMINATION OF MASTER OF TECHNOLOGY (GEOTECHNICAL ENGINEERING) SEMESTER PATTERN

V Semester M. Tech. (Geotechnical Engineering)

Sr. No.	Category	Course Name	L	T	Credits	Maximum marks			Exam Duration	Category
						Continuous Assessment	End Sem Exam	Total		
1.	CET 674	Program Elective I	4	-	4	40	60	100	3 Hours	PE
2.	CET 675	Program Elective II	4	-	4	40	60	100	3 Hours	PE
3.	CEP 676	Project Phase I	-	3	6	50	50	100	-	PC
		TOTAL	**8**	**3**	**14**					

Course Code	Program Elective I (T)
CET 674-1	Special Geotechnical Construction
CET 674-2	Geotechnical Earthquake Engineering

Course Code	Program Elective II (T)
CET 675-1	Pavement Analysis and Design
CET 675-2	Rock Mechanics

SCHEME OF EXAMINATION OF MASTER OF TECHNOLOGY (GEOTECHNICAL ENGINEERING) SEMESTER PATTERN

V Semester M. Tech. (Geotechnical Engineering)

Sr. No.	Category	Course Name	L	T	Credits	Maximum marks			Exam Duration	Category
						Continuous Assessment	End Sem Exam	Total		
1.	CEP 771	Project Phase II	–	6	12	100	100	200	–	PC
		TOTAL	**–**	**6**	**12**					

Semester	L	P	Credits	Maximum Marks		
				Internal Assessment	End Semester Examination	Total
First Semester	12	4	14	170	230	400
Second Semester	14	4	16	210	290	500
Third Semester	16	2	17	185	265	450
Fourth Semester	8	3	14	130	170	300
Fifth Semester	0	6	12	100	100	200
Total	**50**	**19**	**73**	**795**	**1055**	**1850**

I SEMESTER

Syllabus of Semester I, M. Tech. (Geotechnical Engineering)

Course Code: CET571 | **Course: Advanced Soil Mechanics**
L:4 Hrs., P:0 Hrs., Per Week | **Total Credits : 4**

Course Outcomes :

1. Student will understand engineering properties of soil through advanced parameters
2. To make students understand soil structure, stress-strain characteristics of soils, the mechanism of failure, the factors that affect the shear strength and the various test procedures to determine the shear strength.
3. Also, to impart knowledge about three dimensional consolidation, secondary consolidation and basics of rheological models

Syllabus Effective Stress :

Concepts of effective stress in soil, its computation under various conditions, effective stress in partly saturated soil. Stress states at a point under applied stress, limit equilibrium concept in geomechanics, principal stresses at failure in C-ø Soil, Mohr's stress circles.

Shear strength of soils :

Mohr Coulomb`s theory, Drainage conditions and field problems, UU, CU & CD tests, Skempton`s equation for pore pressure, shear strength characteristic of cohesive and cohesionless soil, volume changes during shear and stress dilatancy, critical void ratio & its determination, factor affecting shear strength of cohesive and cohesionless soil, apparent cohesion, concept of stress paths, Kf & Ko lines , stress paths for cases of foundation loading, excavation, active & passive earth pressure conditions, stress-strain models and constitutive relations, Duncan-Chang model.

Transient Flow :

3-D consolidation equation, mathematical solution of Terzaghi's 2-D consolidation equation, characteristics of the theoretical consolidation curve, distribution of consolidating pressure, field consolidation curve, determination of consolidating property parameter, av, mv, cc, cv and pc, secondary consolidation. Typical flownet and flownet for anisotropic soil.

Text books:

1. Fundamentals of soil mechanics: Taylor D.W., Asia Publishing House (1964)
2. Principles of Soil Mechanic: Scott R.F., Addison-Wesley Publication co. (1963)
3. T.B. of Soil Mechanics & Foundation Engineering: Murthy VNS, CBS pub.(2004)

Reference books:

1. Geotechnical Engineering-principles & practices: Coduto D.P., Peavson Edn. Asia, (2002)
2. Basic and Applied soil mechanics: Gopal Ranjan & A.S. Rao, New Edge Int. Ltd., (2004)
3. Principles of Geotechnical Engineering: Das B.M., Thomson Bks, Cengage publication (2002)

I SEMESTER

Syllabus of Semester I, M. Tech.
(Geotechnical Engineering)

Course Code: CEP571 | **Course: Advanced Soil Mechanics**
L:0 Hrs., P:2 Hrs., Per Week | **Total Credits : 1**

Course Outcomes :

At the end of the course students will be able to;

1. Determine shear strength of soils using different methods
2. Conduct tests for determining swellability of expansive soils

List of experiments :

1. Direct shear test on saturated soil (UU-Test)
2. Triaxial shear test on saturated soil (UU, CU-test) with pore pressure measurement
3. UCS-test on clayey soil (saturated)
4. Consolidation test for clay soils
5. Hydrometer analysis of clayey soil
6. Swelling pressure determination for clay soils

The test report shall be submitted in the form of the Journal and same shall be assessed by the concerned teacher/s through viva-voce examination.

I SEMESTER

Syllabus of Semester I, M.Tech. (Geotechnical Engineering)

Course Code: CET572 | **Course : Geotechnical Exploration & Investigation**
L: 4 Hrs, P:0 Hrs, Per Week | **Total Credits : 4**

Course Outcomes :

1. Students will be able to determine the properties of soil.
2. To familiarize the students with principles of exploration, geophysical methods, modern methods of drilling, sampling, offshore investigation and instrumentation.
3. Students will able to undertake various field techniques used in geotechnical engineering for ascertaining the nature and behavior of soil strata.

Syllabus

Importance and objects of Geotechnical exploration:

Principal methods of subsurface exploration, open pits and shafts. Types of borings, selection of suitable boring type; stabilization of boreholes; the number, location and depth of boring for different structures, and for different nature of ground profile.

Planning of subsurface exploration program for major civil engineering project.

Indirect methods of exploration:

Seismic refraction method, electrical resistivity method, qualitative and quantitative interpretation of test results, limitations.

Sampling:

Types of soil samples & their suitability, precautions in sampling, parameter for sampler design, boring and sampling records handling, preservation & shipment of samples; underwater sampling.

Field investigation:

Standard Penetration test, static cone and dynamic cone penetration tests, DMT (Dialotometer Test), interpretation of test results and correlations for obtaining design soil parameters of cohesive and cohesion less soil, field vane shear test , Design value of undrained strength of clays, correction factor; ground water table location.

Plate load test – purposes, procedure, interpretation for bearing capacity and settlement of foundation. Pressure meter test – Principle, equipment, use & interpretation of results, Sub-surface Investigation Report: Salient features and boring logs; Soil survey and Mapping: methods of soil survey introduction of remote sensing. Field Instrumentation: Rollers, Sensors, Inclinometers. Equipments used for boring.

Text books :

1. Basic and Applied soil mechanics: Gopal Ranjan & A.S. Rao, New Edge Int. ltd., (2004)
2. Soil Mechanics and Foundation Engineering: K.R. Arora, Standard Publisher and Distributor, 1949 and later.
3. Foundation Analysis & Design: Bowles, J.E., McGraw Hill (1996)

Reference books:

1. Soil Mechanics in Theory and Practice: Alam Singh, Asia Publisher and Distributor, 1975
2. Advanced Foundation Engineering: Murthy VNS, CBS publishing, (2007)
3. Foundation Engineering Handbook: Fang, H.Y., CBS publishing, (2004)

I SEMESTER

Syllabus of Semester I, M.Tech. (Geotechnical Engineering)

Course Code: CEP572 | **Course : Geotechnical Exploration & Investigation**
L:0 Hrs., P:2 Hrs., Per Week | **Total Credits : 1**

Course Outcomes :

1. Student will have an ability to identify geotechnical properties of soil.
2. Student will have an ability to determine the various index and engineering properties.
3. Students will able to conduct various field test and its applications related to geotechnical engineering.

Practical work shall comprise of :

I) Laboratory test on C-ø soil (by groups of 2 students):

1. Determination of granulometry by sedimentation analysis.
2. Determination of Relative density of sand
3. To calculate dry density of soil
4. To calculate CBR Value of soil.
5. Flow chart & spreadsheet applications in a soil laboratory test Grain size analysis & Shear Strength

II) Field tests (by group of maximum 4 students) any three from the following:

1. Standard penetration test.
2. Static Cone Penetration test
3. Plate load test. (Demonstration)
4. Pressure meter test
5. Preparation of Detail soil Investigation Report

The test report shall be submitted in the form of the Journal and same shall be assessed by the concerned teacher/s through viva-voce examination.

I SEMESTER

Syllabus of Semester I, M.Tech.
(Geotechnical Engineering)

Course Code: CET595 | **Course : Engineering Computational Techniques**
L:4 Hr., P:0 Hrs., Per week | **Total Credits : 4**

Course Outcomes :

1. The graduates will be able to analyze various mathematical problems involved in structural/geotechncal engineering.
2. The graduates will be able to develop computer program/applications for solving various mathematical methods involved in structural/geotechnical engineering.

Syllabus

Solution of algebraic equations : Bisection Method, Regula Falsi Method, Newton-Raphson method, Development of Computer Program.

Solution of linear algebraic equations : Direct methods and iterative methods Eigen values problems : Direct, Jacobi, LR method, QR method.

Initial & two point boundary value problem : Euler's, Runge-Kutta, Milne's Methods, Development of Computer Program.

Numerical Integration : Trapezoidal Method, Simpson's Method, Gauss Quadrature, Development of Computer Program.

Direct Integration Methods : Central difference method, Houbolt method, Newmark's method, Wilson - 8 method.

Text Books :

1. Numerical methods, Principles, Analyses and Algorithms: Srimanth Pal, Oxford University Press, New Delhi.
2. Numerical Methods in Finite Element Analysis: Bathe K. J., Wilson E. L., Prentice-Hall of India Private Limited, New Delhi, (1987).

Reference Books :

1. Numerical Methods: Kandasamy P., Thilagavathy K. and Gunavathi K., S. Chand & Company Ltd, New Delhi, (1997)
2. Numerical Methods for Engineers with Programming and Software Applications: Chapra. S. C. and Canale R. P.,3rd ed., Tata McGraw Hill, New Delhi, (2009).
3. Numerical Mehtods: Salvadori M., PHI learning Pvt, ltd., New Delhi, (1987)

II SEMESTER

Syllabus of Semester II, M.Tech. (Geotechnical Engineering)

Course Code: CET573 | **Course : Foundation Engineering I**
L:4 Hrs., P:0 Hrs, Per Week | **Total Credits : 4**

Course Outcomes :

1. To study basic features and theory regarding shallow foundations.
2. To familiarize students with different types of shallow foundations, analysis and geotechnical design of shallow foundations.
3. Also, to acquaint students with foundations provided in various soil conditions, flexible analysis and soil- structure interaction models.

Syllabus

Ultimate bearing capacity of shallow foundation:

Types of foundation, types of shear failure in foundation soil, Overview of theories of bearing capacity under centric, inclined & vertical loads; Terzaghi's theory, Meyerhof's, Vesic. Ultimate load computation for shallow footing; analysis for footing on 2 layer soil systems of various nature. Theoretical approaches for footings on slope and at the top of slope.

Ultimate & allowable b.c. determination and settlement estimation from a field test, by penetration test (SPT & SCPT), plate load test and pressure meter test.

Settlement analysis:

Concept of seat of settlement, Boussinesq's theory, pressure distribution for strip load, square and circular areas, pressure bulbs, contact pressure and its distribution, Method of computation of elastic settlement, computation of primary and secondary consolidation of foundation on NCC & OCC; Differential settlement & its permissible values. Control of excessive settlement, Raft foundations Necessity; Types of rafts; Bearing capacity and settlement of rafts. RCC Design: Raft design for shallow individual and combined footing. Types of rafts; Bearing capacity and settlement of rafts, design of raft footing, beams on elastic foundation, proportioning the footings for equal settlement.

Text books:

1. Principles of Foundation Engineering: Das B.M., PWS publishing co., (1999)
2. Foundation Analysis & Design: Bowles J.E., McGraw Hill, (1996)
3. Shallow Foundation: Das B.M., CRC Press, (2009)

Reference books:

1. Foundation Engineering: Verghese P.C., Prentice Hall of India, (2007)
2. Advanced Foundation Engineering: Murthy V.N.S., CBS Publishing, (2007)
3. Theory & practice of foundation Design: Som N.N. & Das S.C., Prentice Hall Edn, Asia (2002)

II SEMESTER

Syllabus of Semester II, M.Tech. (Geotechnical Engineering)

Course Code: CEP573 | **Course: Foundation Engineering I**
L: 0 Hrs, P:2 Hrs., Per Week | **Total Credits : 1**

Course Outcomes :

1. Student will have an ability to design shallow foundation on homogeneous and layered soil deposit.
2. Student will have an ability to predict and calculate settlement of foundation.
3. Student will have an ability to determine bearing capacity and settlement characteristics from the different field test.

Practical work shall comprise of :

I) Bearing capacity & settlement problems Solutions of problems on bearing capacity and settlement of footings and rafts for different cases of soil system, types of loading and using various analytical approaches (Minimum 6 assignments)

II) Working out a complete analysis & design of shallow foundation (footings or raft), With respect to soil failure and Geotechnical failure, for a given locations of columns and column loads of framed building and for a given ground characteristics.

The terms work shall be submitted in the form of a journal for the above work and shall be assessed by the concerned teachers through viva-voce examination.

II SEMESTER

Syllabus of Semester II, M. Tech. (Geotechnical Engineering)

Course Code: CET596 | **Course : Research Methodology**
L:3 Hrs., P:0 Hrs., Per Week | **Total Credits : 3**

Course Outcomes :

1. The graduates will be able to define research problems describe the research process and research methods for execution of research project in relevant field.
2. The graduates will be able to know how to apply the basic aspects of the research process in order to plan and execute a research project.
3. The graduates will be able to adopt various numerical method and mathematical tools for analysis of research data.
4. The graduates will be able to understand ethics in research.

Syllabus:

What is Research?, How to do Research, The Objective of Research, Motivation in Research, Types of Research, Various Research Approaches, Significance of Research.

Research Methods, What is Research Methodology, Research Process, What is Research Problem, Various Components of Research Problem, How to Identify the Research Problem, Steps involved in formulation of Research Problem, Necessity and Techniques involved in Defining Research Problem, Feasibility Check.

What is Hypothesis?, its Characteristics, Examples and Types, Hypothesis Testing, Concepts and Procedure of Hypothesis Testing.

Data Collection, Methods of data collection, Primary Data, Secondary Data, Analysis of data, Simple regression, Multiple regression, linear and nonlinear correlation and regression .

Optimization, Principle, linear programming technique, simplex method, evolutionary programming techniques.

Model analysis of structures, direct and indirect method, dimensionless terms and their significance, Geotechnical similitude's, optimization of model.

Research Paper and its contents, Choice on topic, Method of writing research paper, Plagiarism including rules of plagiarism.

Reference Books :

1. Research Methodology- Methods and Techniques: Kothari C.K. (2004), 2/e, New Age International, New Delhi

2. Simulation Modeling and Analysis, 2nd ed.: Law, A. M., and W. D. Kelton, 1991, , McGraw Hill

3. Applied Statistics & Probability for Engineers: Montgomery, Douglas C. & Runger, George C. (2007), 3/e, (Wiley India)

4. Research Methods: A Modular Approach: 2nd edition, Sherri L. Jackson, Wadsworth Cengage Learngin, Belmont, USA

5. Schaum's Quick Guide to Writing Great Research Papers: Laurie Rozakis, 2nd edition, McGraw Hill, New York, USA.

II SEMESTER

Syllabus of Semester II, M.Tech. (Geotechnical Engineering) | Group Elective I

Course Code: CET597-1 **Course: Applied Soil Engineering**
L:4 Hrs., P:0 Hrs., Per Week **Total Credits : 4**

Course Outcomes:

1. The graduate will have knowledge in the engineering behavior of soils such as arching, soil pressure on conduits and silos.
2. The graduate will have knowledge in geotechnical design of different types of earth retaining structures.
3. The graduate will be able to apply basic concepts in soil engineering for analysis of complex geotechnical problems.

Syllabus

Earth pressure theories:

Theories of earth pressure, general and local states of plastic equilibrium, Active and passive states in cohesive and cohesion less soils, Rankine's and Coulomb,s approaches, effects of wall movement, uniform surcharge, wall angle, wall friction, back fill slope; lateral pressure on wall due to concentrated construction, Culmann's method; , earth pressure at rest.

Retaining Walls :

Types of retaining wall, Stability analysis of rigid type and R. C. cantilever type retaining walls, introduction of Georeinforce wall, Gabion wall, soil nailing.

Sheets pile walls:

Types, analysis and design of cantilever and anchored sheet pile walls in cohesive and cohesion less soil, bulkheads, analysis with free earth and fixed earth supports. Rowe`s moment reduction factors, location of deadman and its anchorage capacity.

Cofferdams :

Types, suitability, stability analysis and design of cellular and diaphragm type cofferdams, TVA method for various failures, interlock stress, stability of cellular cofferdams in deep sands and clays.

Stability of slopes :

Finite and infinite slopes, analysis for stability of slopes of embankments, cuts and earth dams. Critical conditions, plane and curved failure surfaces, centre of critical slip circle; slices method with inter slices forces, pore pressures and seepage forces, Ø-circle method, Taylor's stability numbers & stability curves; Bishop's method, Bishop-Morgenstern stability coefficient, Use of design charts

based on Ø-circle method and Bishop`s method. Stability of earth dam slopes during steady seepage and sudden drawdown conditions, Filters types, selection and design criteria, Remedial measures to improve the slop stability.

Text books:

1. T.B. of soil mechanics and foundation engineering: Murthy VNS, CBS pub. (2004)
2. Principles of Geotechnical Engineering: Das B.M.,Thomson Bks, Cengage publ.(2002)
3. Geotechnical Engineering-principles & practices: Coduto D.P., Peavson edn. Asia, (2002)

Reference books:

1. Principles of Foundation Engineering: Das B.M., PWS publication co., (1999)
2. Foundation Analysis & Design: Bowles, J.E., McGraw Hill (1996)
3. Theory & practice of Foundation Design: Som N.N. & Das S.C., Prentice Hall Edn, Asia (2002)

II SEMESTER

Syllabus of Semester II, M.Tech. (Geotechnical Engineering) | Group Elective I

Course Code: CEP597-1 **Course: Applied Soil Engineering**
L:0 Hrs, P:2 Hrs., Per Week **Total Credits : 1**

Course Outcomes :

1. The graduate will have an ability to calculate pressure on conduits and silos.
2. The graduate will have an ability to design different types of earth retaining structures.
3. The graduate will have an ability to determine soil engineering for analysis of complex geotechnical problems.

Work out the Design/ solution of minimum 6 problems/ assignments from the following:

1) Design of cantilever bulkhead in cohesive soil retaining granular backfill.
2) Design of anchored bulkhead by free earth support method.
3) Design of anchored bulkhead by fixed earth support method.
4) Design of braced cofferdam.
5) Culmann's graphical method for active or passive pressure on cantilever wall retaining broken surface backfill with concentrated load.
6) Poncelet construction for active and passive pressure on gravity retaining wall with sloping backfill.
7) Stability of homogeneous C-Ø soil slope by slices method of F- circle method (for min. F.S.I) (software based)
8) Stability of homogeneous C-Ø soil slope by Bishop method (for min. F.S.I) (software based)

The work shall be submitted in the form of Journal of above, and same shall be assessed by the concerned teacher/s through viva-voce examination.

II SEMESTER

Syllabus of Semester II, M. Tech.
(Geotechnical Engineering) | Group Elective I

Course Code: CET597-2
L:4 Hr., P:0 Hrs., Per week

Course : Finite Element Method
Total Credits : 4

Course Outcomes :

1. The graduates will be able to understand solution methodologies for solving complex stress analysis problems.
2. The graduates will be able to understand the general steps of finite element methods and be able to derive equations in finite element methods for 1D, 2D and 3D problems.
3. The graduates will be able to develop element stiffness matrix equation, Assemble element matrix equations into a global matrix, solve the resulting system and interpret the results obtained.
4. The graduates will be able to learn advanced topics and techniques in finite element methods and implement of these techniques to solve advanced stress analysis problems.

Syllabus:

Principles and discretization, Elements stiffness formulation based on direct and variational techniques, Raleigh Ritz Method for Bar and Beam analysis.

Shape functions, Finite Element Formulation using Cartesian Coordinates, Application to 1D problems, Convergence criteria.

Triangular and Rectangular element formulation using Cartesian Coordinates, Application to 2D stress analysis.

Natural coordinates, Numerical integration, Isoparametric elements, Application to 1D Problems, Isoparametric elements for two-dimensional stress analysis

Axisymmetric Stress Analysis. Tetrahedral and hexahedral element formulation, Application to 3D stress analysis.

Modeling techniques and solution techniques, Computer Implementation of FEM Procedure for 1D, 2D & 3D problems.

Text Books :

1. Introduction to Finite Element Method, P. N. Godbole, I. K. International Publishing House Pvt. Ltd., (2013).
2. Introduction to Finite Elements in Engineering: Chandrapatla T. R. and Belegundu A. D., Prentice Hall, India, (1991).

3. A First Course in the Finite Element Method: Logan D. L, Thomson Publishing (2007)

4. "Finite Element Analysis: Theory and Programming", 2nd ed.: Krishnamurthi C. S., Tata Mc Graw Hill Publishing Company Limited, 1994, Reprint 2005.

5. Concepts and Applications of Finite Element Analysis, 3rd ed.: Cook R. D., Wiley India Text books, Wiley India Pvt. Limited, New Delhi, (1989).

Reference Books:

1. The Finite Element Method (Volume -I), 1st ed.: Zienkiewicz O. C. and Taylor R. L., Tata McGraw Hill Publishing Company Limited, New Delhi, (1989).

2. Introduction to Finite Element Method: Desai C. S. and Abel J. F., Van Nostrand Reinhold, New York (1972)

3. "Finite Element Procedure": Bathe K. J., Prentice-hall of India, New Delhi,(1997).

4. Finite Element Analysis in Engineering Design: Rajasekaran S, S. Chand & Co.Ltd. New Delhi, (1999).

II SEMESTER

Syllabus of Semester II, M. Tech.
(Geotechnical Engineering) | Group Elective I

Course Code: CEP597-2
L:0 Hr., P:2 Hrs., Per week

Course : Finite Element Method (P)
Total Credits : 1

Course Outcomes :

1. The graduates will be able to identify the necessary information required to conduct a structural analysis using finite element software
2. The graduates will be able to interpret the solutions obtained from finite element analyses.
3. The graduates will have basic skills in using commercial finite element software and effective presentation of their analysis results.
4. The graduates will be able to communicate effectively in writing to report (both textually and graphically) the method used, the implementation and the numerical results obtained.

Syllabus:

Analytical Solution & Computer Simulation of following problems.

1. Truss
2. Bor
3. Beams
4. 2D plane stress problem
5. 2D plain strain problem
6. 2D Axisgunmetric problem
7. 3D problem

II SEMESTER

Syllabus of Semester II, M. Tech. (Geotechnical Engineering) | Group Elective I

Course Code: CET597-3
L:4 Hr., P:0 Hrs., Per week

Course : Instrumentation and Material Science
Total Credits : 4

Course Outcomes :

1. The graduates will have fundamental understanding of the theoretical basis of various measuring instruments used in structural health monitoring.
2. The graduates will be able to select and apply appropriate instrument, method of analysis for measurement of quantities like strain, strength, etc.
3. The graduates will be able to carry out meaningful interpretation of data obtained from various instruments and produce quantities report of measured parameter.

Syllabus:

Study of various transducers & Principle of their working, displacement velocity acceleration.

Stress-strain measurement, strain gauges static and dynamics strain measurement, Calculation of stresses from measurement of strain, deflections etc.

Special materials for building constructions i. e. steel fibre reinforced concrete, fibre reinforced plastics. Non-destructive testing of concrete / steel / ultrasonic techniques etc, model Analysis related to structures. Admixture for concrete, theories of corrosion and its preventions.

Special concrete like lightweight concrete, no fines concrete, Ferro cement, fly ash concrete etc. high performance concrete.

References Books:

1. Experimental Stress Analysis: Singh, Sadhu Khanna Publishers.
2. Instrumentation in Industry: Soisson, H. E. John Willey & Sons, NY, 1975
3. Corrosion of Steel in Concrete: Boon Field, J. P. E & FN SPON, 1997.
4. Modal Analysis of Structures: Ganesan, T. P., University Press,2000
5. "IS: 13925 Repair and Seismic Strengthening of Buildings- Guidelines", Bureau of Indian Standard, New Delhi, 1993.
6. "SP: 25 Causes and Prevention of Cracks in Buildings", Bureau of Indian Standard, New Delhi, 1984.

II SEMESTER

Syllabus of Semester II, M. Tech.
(Geotechnical Engineering) | Group Elective I

Course Code: CEP597-3 **Course: Instrumentation and Material Science (P)**
L:0 Hr., P:2 Hrs., Per week **Total Credits : 1**

Course Outcomes :

1. The graduates will able to identify suitable measuring instruments for structural health monitoring.
2. The graduate will be able to operate various instruments, interpret the results and will be able to prepare a report.

Syllabus:

Minimum Six practical's based on Theory syllabus.

II SEMESTER

Syllabus of Semester II, M. Tech. (Geotechnical Engineering) | Group Elective I

Course Code: CET597-4 **Course: Soil Dynamics**
L:4 Hrs., P:0 Hrs., Per Week **Total Credits : 4**

Course Outcomes :

1. To enhance Student's knowledge in dynamic loading, theory of vibrations, dynamic soil properties, dynamic earth pressure, dynamic bearing capacity, vibration isolation, liquefaction of soils
2. To train the students in machine foundation design.
3. To realize the occurrence of liquefaction and the analyzing it.

Syllabus:

Dynamic properties of soil :

Idealization of soil as elastic material for dynamic analysis, elastic constant (E,G) and damping property, coefficient of elastic uniform compression and shear, their determination from elasticity theory; Laboratory test and field test to determine dynamic properties. Salient feature and interpretation of resonant column test. Ultrasonic pulse test, block resonance test and cyclic plate load test, factor affecting elastic properties of soil, damping form hysteresis loop, shear models of cohesive and cohesion less soils for low and high strain amplitude problems, application Hooke's law to soil, influence of initial stresses in soil on its elastic deformation, Cross hole propagation test.

Theory of vibration and machine foundation:

Time dependent forces on soil foundation system and their frequency ranges, nature of dynamic forces from m/c forces and earth quake, mass-spring analogy for m/c foundation analysis, theory of free and forced vibration with and without damping, dynamic response characteristics, concept of apparent soil mass, elastic half space approach, Richart's solutions, correlation and comparison of dynamic response evaluation from mass-spring analogy and elastic half space approach.

Machine Foundation Design:

Type of machines, dynamic force characteristics, Analysis and design of single engine reciprocating and impact type machine foundation under vertical dynamic forces; Design and analysis of block foundation, frame foundation (Turbo engine). Computation of dynamic force, method of decreasing vibration of foundation, Analysis and design of m/c foundation with dynamic dampness and absorbers. Vibration isolation and vibration screening. Permissible amplitude of vibration.

Liquefaction of soil:

Phenomenon, liquefaction induced failures, factors affecting liquefaction, Evaluation of liquefaction

potential, concept of cyclic stream ratio (CSR), CSR developed by design earthquake and that required to produce liquefaction, SPT based approaches, CPT based approach, remedial measures to prevent liquefaction.

Text books:

1. Geotechnical Earthquake Engineering: S.L. Kramer, Prentice Hall of India (1996)
2. Vibration of soil and foundation: Richarts, Hall and Woods, Prentice Hall of India (1970)
3. Advanced Foundation Engineering (Chapter 15): VNS Murthy, CBS Publisher (2007)

Reference books:

1. Geotechnical Engineering: D.P. Coduto, Pearson Education Asia, (2002)
2. Soil Dynamics: Shamsher Prakash
3. Theory and Practice of Foundation Design: N.N. Som and S.C. Das, Prentice Hall of India (2003)
4. Basic of Soil Dynamics: Das B.M. , Ramana G.V.,
5. NPTEL Videos on Soil Dynamics

II SEMESTER

Syllabus of Semester II, M. Tech. (Geotechnical Engineering) | Group Elective I

Course Code: CEP597-4 **Course : Soil Dynamics**
L:0Hrs., P:2 Hrs., Per Week **Total Credits : 1**

Course Outcomes :

1. To enhance Student's knowledge in dynamic loading, theory of vibrations, dynamic soil properties, dynamic earth pressure, dynamic bearing capacity, vibration isolation, liquefaction of soils
2. To train the students in machine foundation design.
3. To realize the occurrence of liquefaction and the analyzing it.

Syllabus:

Each student shall complete the following design assignments indivisually (with different data)

1. Analysis and design of reciprocating machine foundation by;

a. Barken's approach using Cu, with and without apparent soil mass consideration.

b. Pauw's method for spring constant and apparent soil mass.

2. Analysis and design of reciprocating machine foundation with spring absorber system.
3. Analysis and design of forge hammer foundation.
4. Evaluation of liquefaction potential of given ground for a known design earthquake.

The work record shall be submitted in the form of journal and the same shall be assumed by concerned teacher through viva voce examination.

II SEMESTER

Syllabus of Semester II, M. Tech.
(Geotechnical Engineering) | Open Elective

Course Code: CET599-1 **Course: Advanced Construction Material & Techniques**
L:3 Hr., P:0 Hrs., Per week **Total Credits : 3**

Course Outcomes :

1. The graduate will be able to classify and select advance construction materials on the basis of their properties.
2. The graduate will be able to demonstrate the use slip formwork technique in construction.
3. The graduate will be able to understand launching techniques of different civil engineering structures.
4. The graduate will be able to identify and suggest advance construction materials for improvement in functional performance of building components

Syllabus:

Construction materials: Classifications, selection criteria for construction materials. Materials Engineering concept: Consideration of physical, Mechanical, thermal, and other Properties. nature of materials.

Ceramic Materials: Properties, Processing of ceramic, classification, refractories, glass, uses and application Engineering wood products Types of Plastics, Properties & Manufacturing process, Advantages of Reinforced polymers Types of FRP, FRP on different Geotechnical elements, Applications of FRP.

Composites: requirements, classification, microscopic composites, macroscopic composites, their applications.

Thermal performance of materials and insulating materials Acoustics and sound proofing methods and materials False ceiling.

Types and properties of Water Proofing Compounds, Types of Flooring and Facade Materials and its application.

Launching Techniques-Suspended formwork-erection techniques of tall structures, Large span structures- in high rise structures. Erection of Lift.

Slip formwork techniques, Grouting methods.

Text Books:

1. Engineering materials: Polymers, Ceramics and composites, Bhargava A K, PHI Publications, Second edition, 2012

2. Engineering Materials, Rangawala S.C., Chortor Publications

3. Building Materials, S.K. Duggal, New Age International Publications, Fourth edition, 2012

4. Building Materials Technology Geotechnical Performance & Environmental Impact, L. Reed Brantley, Ruth T. Brantley, McGraw Hill Inc Publications.

Reference Books :

1. Materials for Civil and Construction engineers, Michael S Mamlouk, John P Zeniewski, Pearson Publications, Third edition, 2014.

2. Rai Mohan and Jai Singh.M.P," Advances in Building Materials and construction " CBRI Roorkee.

3. Jerry Irvine, " Advanced Construction Techniques ", California Rocketry, 1984.

II SEMESTER

Syllabus of Semester II, M. Tech.
(Geotechnical Engineering) | Open Elective

Course Code: CET 599-3 | **Course : Prestressed Concrete Structure**
L:3 Hr., P:0 Hrs., Per week | **Total Credits : 3**

Course Outcomes:

1. The graduates will be able to understand codal provisions and apply them while designing prestressed concrete structures.
2. The graduates will be able to design various prestressed concrete structural components.

Syllabus:

Basic concepts of prestressing, need for high strength steel & concrete, material and prestressing systems. Limit state design criteria, limit state of collapse and limit state of serviceability.

Design of section for flexure, axial tension, compression & bending, shear & torsion, bond and bearing. Design of post tensioned flexural members.

Design of prestressed concrete pipes Design of prestressed concrete slabs.

Reference Books :

1. Design of Pre-stressed Concrete Structures, Lin, T.Y. and Burns, N.H, John Wiley & Sons, New York.
2. Design of Pre-stressed Concrete Structures, 4th ed.: Krishna Raju, Tata McGraw-Hill, New Delhi.

III SEMESTER

Syllabus of Semester III, M. Tech. (Geotechnical Engineering) | Group Elective II

Course Code: 598-1
L:4 Hr., P:0 Hrs., Per week

Course : Design of Bridges
Total Credits : 4

Course Outcomes :

1. The graduates will be able to understand the philosophy of analysis and design of bridge
2. The graduates will be able to understand the loading conditions, codal provisions and behavior under earthquake of bridge superstructure and substructure

Syllabus:

Types of bridge superstructure and introduction to their design, sub-structure, bearings, IRC / IRS Bridge loadings and other codal recommendations, Performance of Bridges in past earthquakes. Seismic design philosophy for Bridges, State of art Modeling of bridges, Seismic Design of Substructures, Capacity design of substructures and ductile detailing, Seismic design of well and pile foundations, Modeling soil flexibility. Earthquake behavior and Design of retaining wall and Abutments, IS code recommendations. Design of Bearings (Free, Guided and Restrained).

Reference Books :

1. Chen, W.F. and Duan, L, "Bridge Engineering Handbook", CRC Press, 1999.
2. Fintel, M., "Handbook of Concrete Engineering" 2nd Edition, CBS Publishers Delhi, 1986.

III SEMESTER

Syllabus of Semester III, M. Tech.
(Geotechnical Engineering) | Group Elective II

Course Code: CET598-2 | **Course : Design of Environmental Structures**
L:4 Hr., P:0 Hrs., Per week | **Total Credits : 4**

Course Outcomes :

1. The graduates will be able to understand the basic principles used in design of environmental structures like water tanks, pump house, water treatment units, etc.
2. The graduates will be able to understand the behavior of structural components of various environmental structures under standard loading conditions and design them as per codal provisions.
3. The graduates will be able to estimate primary design loads on structural elements consulting appropriate standards and handbooks and combine primary design load cases as per design standards to find critical load combination that governs design.
4. The graduates will be able to employ design procedure as per code of practice for design calculations and prepare drawings in appropriate formats.

Syllabus:

Design of Underground Water Tanks Design of Jack Well/Pump House/Approach Bridge Design of Pretreatment Unit i.e. Clarifloculators, Aerators, Flash Mixers, Sand Filters, etc. Design of Elevated Service Reserviour.

References Books :

1. Guidelines for seismic design of liquid storage tanks: Jain, S. K., Jaiswal, O.R., NICEE, IITK, 2004.
2. Design of liquid retaining concrete structure: Anchor, R.D., Edward Arnold, London, 1992.
3. BIS, IS 3370, "Indian Standard code of practice for concrete structures for the storage of liquids", Part I to IV.
4. Ghali, A, "Circular Storage Tanks and Silos", E & F N Spon, London, 1979.

III SEMESTER

Syllabus of Semester III, M. Tech. (Geotechnical Engineering) | Group Elective II

Course Code: CET598-3 | **Course : Geo-Environmental Engineering**
L:4 Hrs., P:0 Hrs., Per Week | **Total Credits : 4**

Course Outcomes :

1. The graduate will be aware about Geo-Environmental techniques, landfill engineering, and contaminant transport.
2. The graduate will be able to understand the concept of design of waste containment facilities like landfill and waste containment pond.
3. The graduate will be able to understand the importance of recycled and reuse of waste material.
4. The graduate will be able to understand the problem of land erosion and to give the effective solution.

Syllabus:

Surface & subsurface contamination, biological & chemical contamination sources & effect of subsurface contamination, Fate & transport of underground contamination, advection, dispersion, diffusion, sorption, vertilization, chemical reaction, biodegradation radioactive decay. Geo-environmental soils characterization & remediation methods.

Contaminants of solid waste in land fills, characteristics of solid wastes, types of land fills, site selection, shape of size of land fills, liners, covers characteristics of solid wastes, types of land fills, site selection, shape & size of land fill, liners, covers and Leachete collection, waste containment principles, Types of barrier materials, planning & design aspects related to waste disposal. Land fill in ash ponds, infilling ponds & in rocks. Stability of land fills, sustainable waste management. Monitoring surface contamination, stabilization & modification of waste. Case studies in waste handling, soil-waste interaction.

Contaminable of slurry waste; Slurry transported wastes, slurry ponds, operation embankment construction & planning, design aspects, environmental impact & control.

Vertical barriers system & cutoff walls, slurry trench cutoff, backfill design & potential defects, use of bentonite & cement in slurry. Constructional features, use of geosynsthetics in land fills, barriers & cutoff, installation of soil mixed wall barrier by deep soil mixing.

Environmental monitoring around landfills, detection, control & remediation of subsurface contamination; engineering properties & geotechnical reuse of waste materials. Demolition waste dumps, regulations.

Soil erosion and land conservation; causes of soil erosion, factors contributory to erosion, erosion control measures.

Text Book:

1. Geoenvironmental Engineering- Principles and Applications: L.N. Reddy & H.F. Inyang, Marcel Dekkar (2004)
2. Geotechnical Practice for Waste Disposal: D.E. Daniel Chapman and Hall, London(1993)
3. Construction and Monitoring of Landfills: A. Bagchi, John Wiley and Pone N.Y.,(1994)

Reference Book :

1. Geotechnical Engineering (Chapter 09): D.P. Coduto, Pearson Education Asia,(2002).
2. Foundation Engineering Handbook (Chapter 20): H.Y. Fang, CBS Publishers (2004).

III SEMESTER

Syllabus of Semester III, M. Tech. (Geotechnical Engineering) | Group Elective II

Course Code: CET598-4 | **Course : Soil-Structure Interaction**
L:4 Hrs., P:0 Hrs., Per Week | **Total Credits : 4**

Course Outcomes :

1. The graduate will be able to understand the soil behavior and the methods to analyze the models
2. The graduate will be able to solve the problems for beam and plate on elastic medium.
3. The graduate will be able to analyze the pile for its settlement and load distribution.

Syllabus:

Critical study of conventional methods of foundation designs, nature and complexities of soil-structure interaction.

Interaction problems based on theory of sub-grade reaction and classic half space soil models, effects of parameters influencing subgrade modulus.

Application of finite difference and finite element techniques of analysis for evaluation of soil-structure interaction for beams, rafts, thin places, piles, etc, with Winkler foundation and Pasternak model, elastic half space soil support, Settlement of foundation, analysis and computation of initial settlement and consolidation settlement for layered deposit, settlement of raft on NCC, sand, Bowle's finite grid method.

Laterally loaded pile analysis, general equation of flexure, close form solutions, finite difference analysis of piles under lateral loads. Glessers recursive technique, procedure for accounting non-linear soil response. Finite element analysis of laterally loaded piles, effect of axial loading on piles response. Axially loaded piles analysis using stream transfer curve.

Pile head response under general loading, analysis of 2D piles group connected by rigid cap, introduction to elasto-plastic analysis.

Text Book :

1. Foundation Engineering Handbook: H.Y. Fang, CBS Publishers (2004)
2. Numerical Methods in Geotechnical Engineering: C.S. Desai, McGraw Hill (1977)

Reference Book :

1. Foundation Analysis and Design: J.E. Bowles, McGraw Hill (1996)

III SEMESTER

Syllabus of Semester III, M. Tech. (Geotechnical Engineering)

Course Code: CET671 | **Course: Ground Improvement**
L:4 Hrs., P:0 Hrs., Per Week | **Total Credits : 4**

Course Outcomes :

1. To enable students to identify problematic soils and their associated issues.
2. Students will study the various ground improvement techniques.
3. Also, to propose suitable remedial techniques and design.

Syllabus:

Introduction to ground improvement techniques:

Concepts of and essential requirements of ground improvement, classification of ground improvement techniques, economic considerations and suitability.

Compaction and Consolidation:

Theory of compaction, equipment's and control of field compaction, surface compaction and deep compaction, vibrofloatation. Preloading by static loads and by vacuum, accelerated consolidation by sand drains, drainage wicks, fabric drains, and rope drains. Theory of radial consolidation by sand drains, free strain and equal strain cases, design of sand drain layout.

Stabilization:

Methods of stabilization, mechanical stabilization, organic and inorganic stabilizing agents and their characteristics-lime, cement, flyash, bitumen and chemicals, stabilization by electro-osmosis.

Grouting:

Materials and methods of grouting, grout volume and grouting pressure, grout requirements and tests.

Reinforced earth and Geotextiles:

Basic theory of reinforced earth, materials, method, application and design of reinforced earth, characteristics of reinforced earth masses; geotextiles, geogrids and geosynthetics, their basic features, functions and applications.

Stone columns:

Application, layout feature, procedures of installation, vibrofloat, rammed & vibrofloated column, quality control in construction; Analysis for stone column treated ground, unit cell concept, load transfer mechanism, load capacity and settlement analysis, Design for stone column layout for intended requirements, methods of improving the effectiveness of stone column, skirted and cemented stone column technique, geotextiles encased stone column.

Drainage and dewatering:

Methods, layout and design consideration of well point system; introduction to soil nailing and ground anchors

Text books :

1. Ground Improvement Techniques: P.P. Raj, Prentice Hall of India (2005)
2. Engineering Principles of Ground Modification: M.R. Housmann, McGraw Hill (1990)

Reference books :

1. Constructional and Geotechnical Methods in Foundation Engineering: R.M. Koener, McGraw Hill (1945)
2. Design and Construction of Stone Column: FHWA Report no. RD 43/026, (1943)

III SEMESTER

Syllabus of Semester III, M. Tech.
(Geotechnical Engineering)

Course Code : CEP671 | **Course : Ground Improvement**
L:0 Hrs., P:2 Hrs., Per Week | **Total Credits : 1**

Course Outcomes :

1. Student will have an ability to suggest suitable ground improvement techniques.
2. Student will have an ability to design and layout of propose techniques.

The term work shall consist of analysis and design for any THREE of the following design assignments to be carried out by each student individually (with different data).

1. Design of sand layout in soft compressible clay deposit for required (accelerated) rate of consolidation.
2. Design of a reinforced earth retaining wall.
3. Design of stone column layout (using conventional incremented fill material or cemented granular fill material) for intended degree of improvement in safe load carrying capacity of soft soil ground.
4. Analysis and design of skirted stone columns.

The work shall be submitted in the form of a journal and shall be assessed by concerned teacher/s through viva-voice examination.

III SEMESTER

Syllabus of Semester III, M. Tech. (Geotechnical Engineering)

Course Code: CET672 | **Course : Earth and Rock fill Dams**
L:4 Hrs., P:0 Hrs., Per Week | **Total Credits : 4**

Course Outcomes :

1. The graduate will be able select a suitable site, materials and equipment for construction of earth/rockfill dams
2. The graduate will be able to Analyze seepage through a given earth/rockfill dam section and select effective seepage control measures for the prevailing site conditions.
3. The graduate will be able to Design earth and rock fill dams.

Syllabus:

Introduction : Classification of dams- Selection of Site-Basic design requirements-Preliminary section. Seepage through Dam section and its control: fundamentals of seepage flow, flow nets, seepage through dam section and foundation, seepage control filters, Impervious core, drainage.

Control of Seepage Through Foundations: types of foundations trench cutoff, upstream impervious blanket, horizontal drainage blanket, relief wells, drainage trenches, cut-off walls, downstream loading berm.

Foundation treatment: treatment of pervious, impervious and rock foundations, core contact treatment, grouting, foundation excavation.

Stability analysis : critical slip surfaces, test conditions, strength parameters, pore pressures, stability analysis- method of slices, bishops method, Morgenster- price method, jambu method.

Construction of earth dams: construction equipment, procedures for pervious, semi-pervious, impervious and rock fill sections, construction supervision.

Failures and damages of earth dams: nature of failures – piping, settlement cracks, slides, earthquake & miscellaneous damages –case studies.

Rock fill dams : general characteristics, rock fill materials, foundation, construction, deformations, types of dams.

Design of rock fill dams : design of dam section, concrete face and earth core, Nature of failures and damages, case studies.

Reference books:

1. Earth And Rock Dams: Sherard, John Wiley Inc..1963.
2. Embankment Dams: H. D. Sharma, Oxford and IBH Publishing Co..1991.
3. Engineering for Embankment Dams: Bharath Singh and R. S. Varshney, A. A. Balekema Publications, 1995.

III SEMESTER

Syllabus of Semester III, M. Tech. (Geotechnical Engineering)

Course Code: CET673 | **Course : Foundation Engineering II**
L: 4 Hrs., P:0 Hrs., Per Week | **Total Credits : 4**

Course Outcomes :

1. To study basic features and theory regarding deep foundation.
2. To familiarize students with different types of deep foundations such as piles, piers, well foundation etc.
3. Analyze and geotechnical design of deep foundations for axial and lateral load.
4. Also, to acquaint students with foundations provided in various soil conditions, for offshore structure.

Syllabus

Axially loaded pile:

Classification and Uses of pile, Load Carrying capacity of piles is sand and clay, computation of end bearing and skin resistance; and methods, critical length of piles in sands, dynamic formulae: comments and limitations. Group action of piles, overlapping of stresses, group efficiency and effect of pile spacing, Load Capacity of single and multi-undreamed pile. Settlement analysis of single pile and group of pile, load capacity of piles in rock, Negative skin friction, Pile load test and Cyclic pile load test

Laterally loaded piles :

Application, lateral resistance of single pile, long and short piles, failure mechanisms, Approaches of analysis with Winkler model for soil, Reese-Matlock's dimensional analysis, Equivalent Cantilever approach, IS code provisions, p-y concept, construction of p-y curves for piles in soft clays and sands, effect of cyclic loading, salient features & design charts of Brom's analysis for different pile-soil systems.

Well foundation :

Uses, constructional features, sinking of wells, tilt and shift, their rectification, depth of well, grip length. Design of component part of well foundation.

Combined pile raft foundations :

Introduction, necessity, analysis of pile raft foundations.

RCC design : Introduction to IS codes, design of pile and pile cap.

Text books :

1. Principles of Foundation Engineering: Das B.M., PWS publishing co., (1999)
2. Advanced Foundation Engineering: Murthy V.N.S., CBS Publishing, (2007)
3. Foundation Engineering Handbook: H.Y. Fang, CBS Publishing (2004)

Reference books :

1. Foundation Engineering: Verghese P.C., Prentice Hall of India, (2007)
2. Theory & practice of foundation Design: Som N.N. & Das S.C., Prentice Hall Edn, Asia (2002)
3. Foundation for high rise structures : Katzenbech, Leppla and Choudhary (2016)

IV SEMESTER

Syllabus of Semester IV, M. Tech.
(Geotechnical Engineering) | Program Elective I

Course Code: CET674-1 | **Course : Special Geotechnical Constructions**
L:4 Hrs., P:0 Hrs., Per Week | **Total Credits : 4**

Course Outcomes :

1. The graduate will be aware of the latest trends, modern standards and state-of-the-art techniques for solving geotechnical engineering problems.
2. The graduate will be able to develop design a geosynthetic system to meet desired needs such as economic, environmental and sustainability related
3. The graduate will be able to identify, formulates and solve soil stability related problems

Syllabus:

The special geotechnical constructions and process to be studied are: Dewatering, Braced Excavation, Diaphragm walls, Ground (soil and rock) anchors, Soil nailing, Screw piles, Secant pile walls, Gabbion walls, Deep soil mixing walls, Geofoam and Geocells.

The state of the art, studying with respect to the following aspects is expected:

1. Types, uses and applications
2. Construction techniques / methods
3. Equipments, machineries required
4. General design considerations
5. Analysis and quantitative design solution
6. Important case studies (in India and Abroad)

Text Book:

1. Construction of Diaphragm wall: I. Hajal, J. Morton and Z. Regals, series in Engineering Publications
2. Foundation Engineering Handbook: Chapter no. 26, H.Y. Fang, CBS Publishers (2004)
3. Theory & practice of foundation Design: Som N.N. & Das S.C., Prentice Hall Edn, Asia (2002)

Reference Books:

1. FHWA Reports and Publications
2. Relevant IS codes and papers from various refereed journals and proceedings

IV SEMESTER

Syllabus of Semester IV, M. Tech. (Geotechnical Engineering) | Program Elective I

Course Code: CET674-2 **Course : Geotechnical Earthquake Engineering**
L:4 Hrs., P:0 Hrs., Per Week **Total Credits : 4**

Course Outcomes :

1. The graduate will be able understand earthquake magnitude, ground motion.
2. The graduate will be able to estimate the damage potential to the structure
3. The graduate will be able to understand the effects of earthquake on soil-foundation systems

Syllabus:

General introduction to earthquakes, magnitude and intensity of earthquake, elastic waves propagating in soil from source of disturbance, salient features and velocities of P, S and R-waves. Various effects of earthquake on soil-foundation-structure system. Ground motion during earthquake, accelerograms, influence of site profile and soil condition on shaking intensity & associated structural damages, Site response spectrum, induced seismic forces and damage potential of structures.

Text books :

1. Geotechnical Earthquake Engineering: S.L. Kramer, Prentice Hall of India (1996)
2. Vibration of soil and foundation: Richarts, Hall and Woods, Prentice Hall of India (1970)
3. Advanced Foundation Engineering (Chapter 15): VNS Murthy, CBS Publisher (2007)

Reference books :

1. Geotechnical Engineering: D.P. Coduto, Pearson Education Asia, (2002)
2. Soil Dynamics: Shamsher Prakash
3. Theory and Practice of Foundation Design: N.N. Som and S.C. Das, Prentice Hall of India (2003)

IV SEMESTER

Syllabus of Semester IV, M. Tech.
(Geotechnical Engineering) | Program Elective II

Course Code: CET675-1 | **Course: Pavement Design and Analysis**
L: 4 Hrs., P:0 Hrs., Per Week | **Total Credits : 4**

Course Outcomes :

1. Students will able to evaluate stresses and strains for various loading and environmental conditions for flexible and rigid pavements.
2. Students will able to design flexible and rigid pavements.
3. Students will able to analyze and evaluate pavement distresses and select best suited rehabilitation techniques.
4. Students will able to design reinforced flexible pavement

Syllabus :

Theories of pavement design, Factors affecting pavement design; Methods of flexible pavement design- applications of CBR, Burmister, Asphalt Institute, AASHTO and IRC methods. ; Load and temperature stresses in rigid pavements- Westergaard's, Bradburry's and Picket's concepts ; Design of rigid pavements by PCA, AASHTO and IRC methods ; Design of joints in rigid pavements ; Evaluation of pavement distress ; Design aspects of flexible and rigid overlays. Rehabilitations Techniques – Reflective Cracking, Reinforced Overlays, Ultra-Thin White Topping

Reference books :

1. Yoder and Witzack, Principles of Pavement Design, John Willey and Sons, October 1975
2. Yang H. Huang, Pavement Analysis and Design, PH,2nd Edition, 2004
3. RILIM Conference Proceedings

IV SEMESTER

Syllabus of Semester IV, M. Tech. (Geotechnical Engineering) | Program Elective II

Course Code: CET675-2 **Course : Rock Mechanics**
L:4 Hrs., P:0 Hrs., Per Week **Total Credits : 4**

Course Outcomes :

1. The graduate will be able to understand engineering properties of rock, classification of rocks.
2. The graduate will be able to carry out laboratory testing of rocks, failure criteria, tunneling in rocks
3. The graduate will be able to understand and adopt various techniques to improve the in situ strength of rocks

Syllabus :

Introduction to rock mechanics : Scope and application of rock mechanics, engineering classification of intact and fissured rocks, RQD, rock exploration, geotechnical description of rock mass.

Engineering properties of intact rock: Porosity, void index, permeability, ultrasonic and electrical resistivity, uniaxial compressive strength, Brazilian test, Griffith`s theory of failure in tension and compression, elastic and dynamic constants, time dependant behavior.

Engineering properties of jointed rock: Anisotropy, deformability and shear strength, rock discontinuity, friction along joints, residual strength, stick- slip theory, Barton`s chaubey`s correlation for shear strength, shear stiffness and dilation.

In- site stress in rock masses: Analysis of stresses, thick wall cylinder formulae, Kreish equation, Green span method, opening in rock mass and stresses around opening, Borehole deformation meters, borehole inclusion stress meters, borehole strain gauge devices.

Underground excavation and subsidence, bearing capacity of homogeneous as well as discontinuous rocks, support pressure & slip of the joint, delineation of types of rock failure, unsupported span of underground openings.

Text Book:

1. Rock mechanics in engineering practice: Stag and Zienkiewiz, John wiley & sons
2. Fundamentals of rock mechanics: Jagger, J.C. & Cook, N.G.W., Methuen & Co. 1971
3. Rock mechanics & Design of structures: Obert, L & Duvall, W.I., John Wiley & Sons

Reference Books:

1. Rock mechanics for engineers: Varma, B.P, Khanna Publishers
2. Introduction to rock mechanics: Goodman, Wiley International

IV SEMESTER

Syllabus of Semester IV, M. Tech.
(Geotechnical Engineering) | Program Elective II

Course Code: CEP676 | **Course : Project Phase I**
L:0 Hrs., P:3 Hrs., Per Week | **Total Credits : 6**

Course Outcomes :

1. To train the students to address to a group of people and to present technical topics in a well organized manner to the audience.
2. It is also intended for improvement of communication skills of students, to make them confident in expressing their views with clarity and to make them capable of taking part in debates/discussion.
3. This will help create self esteem and confidence that are essential for engineers.

Seminar and seminar report based on topic for research for project

V SEMESTER

Syllabus of Semester V, M.Tech. (Geotechnical Engineering)

Course Code: CEP771 | **Course: Project Phase II**
L:0 Hrs., P:6 Hrs., Per Week | **Total Credits : 12**

Course Outcomes :

1. To improve the professional competency and research aptitude by touching the areas which are not covered by theory or laboratory classes.
2. The project work aims to develop the work practice in students to apply theoretical and practical tools / techniques to solve real life problems related to industry and current research.

Seminar / research work based on some topic related to Geotechnical Engineering.

NOTES